

Claims

- [c1] 1. A single stage A/D converter with piezo transformer suitable for converting an AC power into a DC power, comprising:
- a rectification module, having a pair of rectification input terminals, a first rectification output terminal and a second rectification output terminal, wherein the pair of rectification input terminals receives the AC power and converts the AC power into a rectification output signal which is then output from the first rectification output terminal;
 - a switching module, comprising:
 - a bulk circuit, having a bulk input terminal, a first bulk output terminal and a second bulk output terminal, wherein the bulk input terminal electrically couples to the first rectification output terminal for receiving the rectification output signal, and a bulk signal is generated from the first bulk output terminal after the rectification output signal is processed by the bulk circuit;
 - a half-bridge circuit, having a first half-bridge input terminal, a second half-bridge input terminal and a half-bridge output terminal, wherein the first half-bridge input terminal electrically couples to the first bulk output

terminal, and the second half-bridge input terminal electrically couples to the second rectification output terminal;

a first switching diode, wherein an anode electrode of the first switching diode electrically couples to the second half-bridge input terminal, and a cathode electrode of the first switching diode electrically couples to the second bulk output terminal; and

a second switching diode, wherein an anode electrode of the second switching diode electrically couples to the second bulk output terminal, and a cathode electrode of the second switching diode electrically couples to the half-bridge output terminal;

a driving module, electrically coupling to the second bulk output terminal and the half-bridge output terminal of the switching module for blocking a DC bias output from the half-bridge output terminal, and generating a driving signal after the signal obtained from blocking the DC bias is resonated;

a piezo transformer, generating a corresponding piezo transforming signal according to the driving signal; and
an output rectification module, having a rectification circuit and an output load, wherein the rectification circuit rectifies the piezo transforming signal and outputs the DC power from both sides of the output load.

[c2] 2. The single stage A/D converter with piezo transformer of claim 1, wherein the bulk circuit comprises:
a bulk input inductor, wherein one terminal of the bulk input inductor electrically couples to the first rectification output terminal, and another terminal of the bulk input inductor electrically couples to the first bulk output terminal;
a bulk capacitor, wherein one terminal of the bulk capacitor electrically couples to the first bulk output terminal, and another terminal of the bulk capacitor electrically couples to the second bulk output terminal; and
a bulk diode, wherein an anode electrode of the bulk diode electrically couples to the second bulk output terminal, and a cathode electrode of the bulk diode electrically couples to the first rectification output terminal.

[c3] 3. The single stage A/D converter with piezo transformer of claim 2, wherein the switching module further comprises:
a flyback diode, wherein a cathode electrode of the flyback diode electrically couples to one terminal of the output load; and
a flyback transforming inductor induced each other with the bulk input inductor, wherein one terminal of the flyback transforming inductor is connected to a ground terminal, and another terminal of the flyback transform-

ing inductor is electrically coupled to an anode electrode of the flyback diode.

[c4] 4. The single stage A/D converter with piezo transformer of claim 1, wherein the half-bridge circuit comprises: a first switch, wherein a first terminal of the first switch receives the boost signal, and a second terminal of the first switch electrically couples to the half-bridge output terminal; and

a second switch, wherein a first terminal of the second switch electrically couples to the half-bridge output terminal, and a second terminal of the second switch electrically couples to the second rectification output terminal.

[c5] 5. The single stage A/D converter with piezo transformer of claim 1, wherein the rectification module comprises: a diode bridge rectifier, wherein an input terminal of the diode bridge rectifier electrically couples to the pair of the rectification input terminals for receiving the AC power, and an output terminal of the diode bridge rectifier electrically couples to the first rectification output terminal and the second rectification output terminal; and

a rectification capacitor, wherein one terminal of the rectification capacitor electrically couples to the first rectification output terminal, and the other terminal of the

rectification capacitor electrically couples to the second rectification output terminal.

[c6] 6. The single stage A/D converter with piezo transformer of claim 1, wherein the rectification module comprises: a diode bridge rectifier, wherein an input terminal of the diode bridge rectifier electrically couples to the pair of the rectification input terminals for receiving the AC power, and an output terminal of the diode bridge rectifier electrically couples to the first rectification output terminal and the second rectification output terminal.

[c7] 7. The single stage A/D converter with piezo transformer of claim 1, wherein the driving module comprises:
a capacitor;
a first inductor; and
a second inductor,
wherein, one terminal of the capacitor electrically couples to the half-bridge output terminal, another terminal of the capacitor electrically couples to one terminal of the first inductor, another terminal of the first inductor electrically couples to one terminal of the second inductor to serve as an output terminal of the driving module, and the other terminal of the second inductor electrically couples to the second bulk output terminal to serve another output terminal of the driving module.

[c8] 8. The single stage A/D converter with piezo transformer of claim 1, wherein the driving module comprises:
a first capacitor;
an inductor; and
a second capacitor,
wherein, one terminal of the first capacitor electrically couples to the half-bridge output terminal, another terminal of the first capacitor electrically couples to one terminal of the inductor, another terminal of the inductor electrically couples to one terminal of the second capacitor to serve an output terminal of the driving module, and other terminal of the second capacitor electrically couples to the second bulk output terminal to serve as another output terminal of the driving module.

[c9] 9. The single stage A/D converter with piezo transformer of claim 1, wherein the driving module comprises:
a capacitor;
a first inductor; and
a second inductor,
wherein, one terminal of the capacitor electrically couples to the half-bridge output terminal, another terminal of the capacitor electrically couples to one terminal of the first inductor and one terminal of the second inductor, another terminal of the first inductor is an output terminal of the driving module, and another terminal of

the second inductor electrically couples to the second bulk output terminal to serve as another output terminal of the driving module.

[c10] 10. The single stage A/D converter with piezo transformer of claim 1, wherein the driving module comprises:
a capacitor; and
an inductor,
wherein, one terminal of the capacitor electrically couples to the half-bridge output terminal, another terminal of the capacitor electrically couples to one terminal of the inductor to serve an output terminal of the driving module, and another terminal of the inductor electrically couples to the second bulk output terminal to serve another output terminal of the driving module.

[c11] 11. The single stage A/D converter with piezo transformer of claim 1, wherein the driving module comprises:
a capacitor; and
an inductor,
wherein, one terminal of the capacitor electrically couples to the half-bridge output terminal, another terminal of the capacitor electrically couples to one terminal of the inductor, and another terminal of the inductor is an output terminal of the driving module.

[c12] 12. The single stage A/D converter with piezo transformer of claim 1, wherein the piezo transformer comprises two output terminals, and the rectification circuit comprises a first inductor, a second inductor, a first diode, a second diode and a capacitor, wherein, one terminal of the first inductor electrically couples to one output terminal of the piezo transformer and an anode electrode of the first diode, another terminal of the first inductor electrically couples to one terminal of the second inductor and one terminal of the output load, another terminal of the second inductor electrically couples to the other output terminal of the piezo transformer and an anode electrode of the second diode, a cathode electrode of the first diode electrically couples to a cathode electrode of the second diode, one terminal of the capacitor, and another terminal of the output load, and another terminal of the capacitor is grounded.

[c13] 13. The single stage A/D converter with piezo transformer of claim 1, wherein the piezo transformer comprises two output terminals, and the rectification circuit comprises an inductor, a first diode, a second diode, a third diode, a fourth diode and a capacitor, wherein, an anode electrode of the first diode electrically couples to a cathode electrode of the second diode and one output terminal of the piezo transformer, an anode electrode of

the third diode electrically couples to a cathode electrode of the fourth diode and the other output terminal of the piezo transformer, a cathode electrode of the first diode and a cathode electrode of the third diode electrically couple to one terminal of the inductor, the other terminal of the inductor electrically couples to one terminal of the capacitor and one terminal of the output load, and an anode electrode of the second diode and the anode electrode of the third diode electrically couple to the other terminal of the capacitor and the other terminal of the output load.

- [c14] 14. The single stage A/D converter with piezo transformer of claim 1, wherein the piezo transformer comprises two output terminals, and the rectification circuit comprises an inductor, a first diode, a second diode and a capacitor, wherein, an anode electrode of the first diode electrically couples to one output terminal of the piezo transformer, a cathode electrode of the first diode electrically couples to a cathode electrode of the second diode and one terminal of the inductor, another terminal of the inductor electrically couples to one terminal of the capacitor and one terminal of the output load, and an anode electrode of the second diode electrically couples to another terminal of the piezo transformer, the other terminal of the capacitor, and the other terminal of the

output load.

- [c15] 15. A single stage A/D converter with piezo transformer suitable for converting an AC power into a DC power, comprising:
- a rectification module, having a pair of rectification input terminals, a first rectification output terminal, and a second rectification output terminal, wherein the pair of rectification input terminals receives the AC power, converts the AC power into a rectification output signal which is then output from the first rectification output terminal;
 - a switching module, comprising:
 - a bulk circuit having a bulk input terminal and a bulk output terminal, wherein the bulk input terminal electrically couples to the first rectification output terminal for receiving the rectification output signal, and a bulk signal is generated from the bulk output terminal after the rectification output signal is processed by the bulk circuit;
 - a half-bridge capacitor; and
 - a half-bridge circuit, having a first switch, a second switch, and a half-bridge output terminal, wherein one terminal of the first switch electrically couples to one terminal of the half-bridge capacitor, another terminal of the first switch electrically couples to one terminal of the

second switch, the half-bridge output terminal, and the bulk output terminal, another terminal of the second switch electrically couples to the other terminal of the half-bridge capacitor and the second rectification output terminal;

a driving module, electrically coupling to half-bridge output terminal and the second rectification output terminal for blocking a DC bias output from the half-bridge output terminal, and generating a driving signal after the signal obtained from blocking the DC bias is resonated;

a piezo transformer, generating a corresponding piezo transforming signal according to the driving signal; and

an output rectification module, having a rectification circuit and an output load, wherein the rectification circuit rectifies the piezo transforming signal and outputs the DC power from both sides of the output load.

[c16] 16. The single stage A/D converter with piezo transformer of claim 15, wherein the bulk circuit comprises: a bulk input inductor, wherein one terminal of the bulk input inductor electrically couples to the first rectification output terminal, and another terminal of the bulk input inductor electrically couples to the half-bridge output terminal.

[c17] 17. The single stage A/D converter with piezo transformer of claim 16, wherein the switching module fur-

ther comprises:

a flyback diode, wherein a cathode electrode of the flyback diode electrically couples to one terminal of the output load; and

a flyback transforming inductor induced each other with the bulk input inductor, wherein one terminal of the flyback transforming inductor is grounded, and another terminal of the flyback transforming inductor is electrically coupled to an anode electrode of the flyback diode.

[c18] 18. The single stage A/D converter with piezo transformer of claim 15, wherein the rectification module comprises:

a diode bridge rectifier, wherein an input terminal of the diode bridge rectifier electrically couples to the pair of the rectification input terminals for receiving the AC power, and an output terminal of the diode bridge rectifier electrically couples to the first rectification output terminal and the second rectification output terminal; and

a rectification capacitor, wherein one terminal of the rectification capacitor electrically couples to the first rectification output terminal, and the other terminal of the rectification capacitor electrically couples to the second rectification output terminal.

[c19] 19. The single stage A/D converter with piezo transformer of claim 15, wherein the rectification module comprises:
a diode bridge rectifier, wherein an input terminal of the diode bridge rectifier electrically couples to the pair of the rectification input terminals for receiving the AC power, and an output terminal of the diode bridge rectifier electrically couples to the first rectification output terminal and the second rectification output terminal.

[c20] 20. The single stage A/D converter with piezo transformer of claim 15, wherein the driving module comprises:
a capacitor;
a first inductor; and
a second inductor,
wherein, one terminal of the capacitor electrically couples to the half-bridge output terminal, another terminal of the capacitor electrically couples to one terminal of the first inductor, another terminal of the first inductor electrically couples to one terminal of the second inductor to serve as an output terminal of the driving module, and the other terminal of the second inductor electrically couples to the second rectification output terminal.

[c21] 21. The single stage A/D converter with piezo transformer of claim 15, wherein the driving module com-

prises:

a first capacitor;

an inductor; and

a second capacitor,

wherein, one terminal of the first capacitor electrically couples to the half-bridge output terminal, another terminal of the first capacitor electrically couples to one terminal of the inductor, another terminal of the inductor electrically couples to one terminal of the second capacitor to serve as an output terminal of the driving module, and another terminal of the second capacitor electrically couples to the second rectification output terminal.

[c22] 22. The single stage A/D converter with piezo transformer of claim 15, wherein the driving module comprises:

a capacitor;

a first inductor; and

a second inductor,

wherein, one terminal of the capacitor electrically couples to the half-bridge output terminal, the other terminal of the capacitor electrically couples to one terminal of the first inductor and one terminal of the second inductor, another terminal of the first inductor is an output terminal of the driving module, and another terminal of the second inductor electrically couples to the second

rectification output terminal.

- [c23] 23. The single stage A/D converter with piezo transformer of claim 15, wherein the driving module comprises:
a capacitor; and
an inductor,
wherein, one terminal of the capacitor electrically couples to the half-bridge output terminal, another terminal of the capacitor electrically couples to one terminal of the inductor to serve as an output terminal of the driving module, and another terminal of the inductor electrically couples to the second rectification output terminal.
- [c24] 24. The single stage A/D converter with piezo transformer of claim 15, wherein the driving module comprises:
a capacitor; and
an inductor,
wherein, one terminal of the capacitor electrically couples to the half-bridge output terminal, another terminal of the capacitor electrically couples to one terminal of the inductor, and the other terminal of the inductor is an output terminal of the driving module.
- [c25] 25. The single stage A/D converter with piezo transformer of claim 15, wherein the piezo transformer com-

prises two output terminals, and the rectification circuit comprises a first inductor, a second inductor, a first diode, a second diode and a capacitor, wherein, one terminal of the first inductor electrically couples to one output terminal of the piezo transformer and an anode electrode of the first diode, another terminal of the first inductor electrically couples to one terminal of the second inductor and one terminal of the output load, another terminal of the second inductor electrically couples to another output terminal of the piezo transformer and an anode electrode of the second diode, a cathode electrode of the first diode electrically couples to a cathode electrode of the second diode, one terminal of the capacitor, and the other terminal of the output load, and another terminal of the capacitor is connected to a ground terminal.

- [c26] 26. The single stage A/D converter with piezo transformer of claim 15, wherein the piezo transformer comprises two output terminals, and the rectification circuit comprises an inductor, a first diode, a second diode, a third diode, a fourth diode and a capacitor, wherein, an anode electrode of the first diode electrically couples to a cathode electrode of the second diode and one output terminal of the piezo transformer, an anode electrode of the third diode electrically couples to a cathode electrode

of the fourth diode and another output terminal of the piezo transformer, a cathode electrode of the first diode and a cathode electrode of the third diode electrically couple to one terminal of the inductor, another terminal of the inductor electrically couples to one terminal of the capacitor and one terminal of the output load, and an anode electrode of the second diode and the anode electrode of the third diode electrically couple to another terminal of the capacitor and the other terminal of the output load.

- [c27] 27. The single stage A/D converter with piezo transformer of claim 15, wherein the piezo transformer comprises two output terminals, and the rectification circuit comprises an inductor, a first diode, a second diode and a capacitor, wherein, an anode electrode of the first diode electrically couples to one output terminal of the piezo transformer, a cathode electrode of the first diode electrically couples to a cathode electrode of the second diode and one terminal of the inductor, another terminal of the inductor electrically couples to one terminal of the capacitor and one terminal of the output load, and an anode electrode of the second diode electrically couples to the other terminal of the piezo transformer, the other terminal of the capacitor and another terminal of the output load.

